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Preliminary to a survey of a national sample of 40,000 subjects intended to estimate prevalence of speech and hearing disorders in the United States public school population, a mobile unit collected data on a pilot sample of subjects in grades 1 through 12. Speech testing of 6,290 subjects indicated about 85% had articulation which did not deviate from the Adult General American standard while less than 1% deviated extremely. A total of 5% manifested some voice deviation; 0.3% were judged stutterers; and 0.3% deviated extremely in overall speech performance. Threshold hearing data on 6,157 subjects revealed that subject reliability was generally excellent, but increased with grade level. Males showed a higher degree of reliability than females. Superior hearing sensitivity was exhibited by 91.8% of the sample, with females performing better than males in all but grade 2. Only eight of the children deviating from the superior hearing criterion were found to have bilateral impairments (.001% of the sample). The remaining 499 children had unilateral impairments which were about equally divided between the two ears, predominant in males, and well distributed among the grades. Further analysis of the data and modifications in the programing were planned to verify trends, define speech disorder, and describe hearing patterns. (Author/JD)

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Project No. 50978
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NATIONAL SPEECH AND HEARING SURVEY

Forrest M. Hull
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Fort Collins, Colorado 80521

March, 1969

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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SUMMARY

The primary purpose of the National Speech and Hearing Survey project is to estimate the prevalence of speech and hearing disorders in the public school population in the United States. The prevalence estimate is to be based on an analysis of speech and hearing data collected on a national stratified sample of subjects drawn from a sampling frame which was constructed from information on public school enrollments in the United States.

From June, 1965 to October, 1968 a series of exploratory investigations and pilot studies were conducted to formulate a methodology which could be used to collect data on the national sample. During this time a mobile testing unit was designed, constructed, and utilized in a number of feasibility studies involving small samples of subjects.

The methodology which evolved as a result of the preliminary studies includes the use of mobile units in which all speech and hearing data are collected. A survey team consisting of three evaluators and a team coordinator serve as a unit to collect the data in predetermined school districts which are designated as sampling points of which there are a total of 100 in the national sample of approximately 40,000 school age subjects.

During the period of October 1, 1967 - June 1, 1968 a large pilot study was conducted in U. S. Census District No. 8, consisting of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming. Data were collected on 6,290 subjects equally distributed in 21 sampling points (school districts). One mobile unit with a survey team of four persons collected the data.

Results of the preliminary analysis of data collected on the sample of 6,290 subjects in the pilot study are the primary concern of this report.

The preliminary results for speech are reported in terms of deviations from a predetermined speech standard which is essentially the Adult General American dialect. Subjective ratings of articulatory performance, voice, overall speech performance, and the presence or absence of stuttering were made on the basis of connected speech samples.

The results indicate that about 85% of all subjects were judged to have articulation which did not diviate from the AGA standard while less than 1% were judged to deviate extremely from the AGA standard. A total of 5% manifested some voice deviation; 0.3% were judged

stutters, and 0.3% deviated extremely from the standard in terms of overall speech performance.

The preliminary analysis of the data yields results which indicate expected trends. However, such trends in their magnitude must be related to the character of the sample. The first programmed analysis does not provide information which allows for a precise definition of a speech disorder. This can be done only by including subject performances on the articulation test in conjunction with the subjective ratings of speech. Such a program is being written at the present time.

Threshold hearing data were collected on 6,157 males and female subjects representing grades one through twelve. Modified audiometers were employed which permitted precise field calibration on a twice-daily basis. Reliability assessments on all evaluators were also conducted periodically to insure homogeneity of procedures and accuracy of results.

The results obtained reveal that subject reliability was generally excellent, but did increase somewhat with grade level. Males showed a higher degree of reliability than females. Superior hearing sensitivity (0-20 dB re ISO, 1964 reference scale) was exhibited by 91.8% of the total population, with females showing superior performance to males in all but the second grade. Only eight subjects (.001% of the total sample) from among the children deviating from the superior-hearing criterion were found to have bilateral impairments. The remaining 499 children had unilateral impairments which were about equally divided between left and right ears and which were predominant in males and well distributed among the various grades.

A more sophisticated analysis of the hearing data will provide the kind of information which will describe the nature of the hearing patterns of the 8.2% of the subjects who were not included in the group which exhibited superior bilateral hearing acuity.

The preliminary analysis of all data from the pilot study did yield the information needed to evaluate testing procedures and methodology in preparation for data collection on the national sample of 40,000 subjects subsequently.

INTRODUCTION

Speech and hearing services have been provided for children and adults for many years and the demand for increased services has accelerated recently. Yet, in the speech and hearing profession, a reliable estimate of the number of individuals in the United States with oral communication disorders who could benefit from such services is not known.

Many isolated surveys have been conducted but the results have varied drastically and cannot be used in generalizing to the national population. For example previous studies have reported prevalence figures for speech disorders ranging from about 1% to 22% in school populations. With over 45,000,000 public school children on the rolls a safe guess is that there are at least 500,000 who are in need of services but the magnitude of the need must be defined more clearly.

In recent years federal legislation has provided increased financial support to train speech and hearing specialists, training institutions have expanded facilities to meet the demand for professional training and public schools have broadened their concept of public school responsibility for education to include special services for speech and hearing handicapped children. All could plan more realistically for future need if reliable prevalence figures were available.

In 1905 Colorado State University in cooperation with the U. S. Office of Education began a series of studies to determine the feasibility of conducting a national survey to estimate the prevalence of speech and hearing disorders among school children in the United States. Since 1965 the goad of the project has been to develop a feasible method for conducting a survey of such scope. Included among the activities was the study of methods for drawing a reliable national sample, determination of the amount of information to be collected, development of a suitable testing evironment for collecting data on hearing and speech behavior, evaluation of testing instruments and procedures, and the completion of many pilot and subpilot studies to evaluate the total methodological approach. Since the beginning the process has been one of progressive evaluation of all phases of the survey project. The methodology which evolved was used to conduct a large pilot study during the school year 1967-68 involving in excess of 6,000 school-age subjects. Following completion of the pilot study data collection some modifications of the methodology were introduced and the resultant procedure is now being employed to collect data on a national sample of approximately 40,000 public school children in

grades 1-12. The primary purpose of the survey project is to reliably estimate the prevelance of speech and hearing disorders among public school children in grades 1-12.

The purpose of this interim report is to present and discuss some of the results obtained in the pilot study which was conducted in the Rocky Mountain Region during the period October, 1967 - June, 1968. The purpose of the pilot study was test equipment, evaluate procedures and personnel, and to obtain data which, when analyzed, would be useful in refining procedures for the collection of data on the national sample.

There are some interpretive limitations associated with the results reported here. In the first place the restricted nature of the sample limits any generalizations to a population since the data were collected from a sample which consisted of subjects drawn from relatively small urban area; the largest metropolitan area screened was Denver, Colorado. Secondly, the computer programmed analysis used for the initial printout was designed to answer basic questions regarding the data and to serve as a guide for future analysis in the project. The analysis was not intended to answer all possible questions but to point up obvious trends regarding speech behavior which could be compared with some of the professional information which has been reported in the past. Even a cursory look at the analysis immediately suggest numerous interrelationships which must be explored and which would yield valuable information.

METHOD

Sample. For the pilot study data were collected from a sample of 6,290 public school subjects evenly distributed among the twelve grades as shown in Table 1. The 6,290 subjects were equally distributed among 21 sampling points (school districts) located in U. S. Census district #8 which include Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah and Wyoming. The distribution of subjects by sampling point is seen in Table 2. The 21 school districts were drawn from a sampling frame which included only those districts with a minimum of 300 students enrolled.

Testing Equipment. All speech and hearing data were collected in a mobile testing unit which included two speech testing rooms and a 401 Series IAC hearing test chamber.

The testing equipment included a modified Maico 11-A audiometer for testing hearing, Uher 4000 L Report tape recorders for recording speech responses, the Goldman-Fristoe Articulation Test, and stimulus cards designed to evoke connected speech patterns.

Calibration equipment for the audiometers included a Rudmose, Model Ra 106A artificial ear and Simpson-715 Voltmeter.

Survey Team Personnel. A survey team consisting of three evaluators and a team coordinator traveled with the mobile unit and collected data on the sample. All personnel had met the minimum requirements of a bachelor's degree with a major emphasis in speech and hearing. In addition all personnel had received prior training in the data collection techniques to be used in the survey. The team coordinator traveled ahead of the three evaluators to complete final details with the sample school for the evaluator team's visit. Rosters of subjects to be tested were prepared, meetings were held with public school personnel, and the electrical power hookup for the mobile unit was arranged. When the evaluator team arrived for testing,all arrangements had been completed and testing could be started without delay.

General Procedure for Data Collection. All speech and hearing data were collected on each subject individually. Subjects were scheduled for testing in blocks of four and the entire procedure for the four subjects was completed in a 20 minute period. Ten minutes per subject was allowed for speech testing and five minutes per subject for hearing. With this schedule an average of 50 subjects could be tested each day during the normal school-day period. In this report it is convenient to discuss the detailed procedures and results for speech and hearing separately.

TABLE 1. Summary of the total number of subjects tested with speech data reported. Pilot 1967-68.

Grade	1	2	3	4	5	6	7	8	9	10	11	12	Total
Male	267	282	254	261	272	269	266	280	257	278	260	243	3189
Female	262	236	273	259	267	265	258	244	264	250	258	262	3098
Total	529	518	527	520	539	534	524	524	521	528	518	505	6287*

*6,290 subjects were drawn; 3 subjects could not be tested for speech either because they failed to respond or were non-English speaking.

TABLE 2. Sampling points and number of subjects tested at each point. Pilot 1967-68.

Sampling Point	Location	Total Subjects Grades 1-12
1	Billings, Montana	312
2	Helena, Montana	307
3	Choteau, Montana	287
4	Couer d'Alene, Montana	285
5	Payette, Idaho	291
6	Ogden, Utah	300
7	Salt Lake City, Utah	299
8	Vernal, Utah	269
9	Las Vegas, Nevada	273
10	Phoenix, Arizona	303
11	Peoria, Arizona	301
12	Marana, Arizona	312
13	Bisbee, Arizona	311
14	Los Lunas, New Mexico	308
15	Albuquerque, New Mexico	303
16	Sante Fe, New Mexico	303
17	Swink, Colorado	286
18	Colorado Springs, Colorado	301
19	Denver, Colorado	313
20	Aurora, Colorado	312
21	Cherry Creek, Colorado	309
	Total Subjects	6,290

SPEECH BEHAVIOR - Procedure and Results

Procedure. Two methods were used to obtain and evaluate speech behavior. All speech performances for each subject were recorded on tape.

Articulation-(Phonemic Inventory). The first method used to evaluate articulation consisted of administering the 73-item Goldman-Fristoe Test of Articulation and recording on the data sheet an evaluation of correct or incorrect. The Goldman-Fristoe Test is designed to test consonant and consonant blends using picture cards to stimulate speech responses. Some of the pictures evoke a response which enable the tester to evaluate more than one speech element. For example the picture of "house" allows the tester to evaluate /h/ in the initial position and also /s/ in the final position of the word. A total of 35 plates tests 73 speech units in the above manner.

Although the articulation test inventory for all subjects has been tabulated as total scores (number of correct and incorrect phonemes produced), the results have not been analyzed for each subject and are therefore not useful in describing speech behavior in this form. In the next level of data analysis the articulation test results will be related to the results of the subjective evaluations of the connected speech patterns. In this manner a more precise description of the subject's speech will be possible.

Connected Speech. The second method used for evaluating speech performance was by means of subjective judgments of connected speech patterns. The evoked speech was obtained by 1) asking questions of the subject which required narrative-like answers, 2) requiring the subject to "tell a story" in response to a set of pictures presented sequentially and, 3) by having the subject repeat a series of sentences. The evaluator utilized the battery of connected speech responses, to subjectively rate articulation, voice, stuttering, and overall speech performance. The ratings for articulation, voice, and overall speech performance were scaled while stuttering was judged to be either present or absent. Therefore, in each of the speech categories except stuttering, the connected speech pattern was judged to be equivalent to or to deviate to some degree from a predetermined standard. In judging articulation and overall speech performance the evaluator used a form of the Adult General American dialect as the standard pattern to which the subject's responses were compared.

Articulation-(Connected Speech). In rating articulatory performance based on connected speech patterns a three point scale was

used by the evaluator. The three points on the scale indicated a degree of comparison with the AGA dialect standard as shown below.

Acceptable - no deviation from the AGA standard.
Moderate - a moderate or mild deviation from the AGA standard.
Extreme - an extreme or severe deviation from the AGA standard.

Tables 3, 4 and 5 show the results of the judgments of the connected speech sample for all subjects. It is emphasized here that the three judgments rendered are based on a comparison with the Adult General American dialect and therefore Tables 4 and 5 are not interpreted as prevalence figures for articulation disorders of any order of severity.

One might interpret that 85.6% of the subjects exhibited a very high level of articulatory performance as shown in Table 3. Table 4 indicates that a total of 13.6% of the subjects were judged to be less proficient in articulatory performance than those subjects in Table 3 while the results in Table 4 indicate that only 0.8% of the subjects deviated extremely from the AGA standard. The latter group of subjects most certainly do include subjects who could be considered deviant enough to warrant the label of "articulation disorder".

It can be seen in Table 3 that, except for grade seven, female performance was consistently better than male performance in each of the 12 grades. Also a comparison by grades shows that proficiency increases in a regular fashion from grade one through grade twelve. Finally, the results in Table 3 indicate that proficiency increases approximately 50% between the first and second grades; such a magnitude of change does not occur between any other adjacent grade levels. For the most part these results support previous reports of this nature found in the literature.

The superiority of females over males is further indicated in Table 4 which summarizes the "moderate deviations" of articulation although such differences are not found in grades seven, nine, and eleven.

In considering the 50 subjects who were rated as "extremely deviant" in Table 5 the superiority of females over males is more pronounced especially in grade one where 5.2% of the males were judged to deviate extremely as compared to 3.1% of the females. In summary, a comparison of the results in Tables 3, 4, and 5 suggest that judgments are consistent in the sense that the trends of performance are consistent and logical with respect to degree of deviation, sex and age.

Detailed comparisons of the ratings with the articulation test anal-

TABLE 3. Acceptable Articulation. Number and percentage of subjects judged to have an articulation pattern which did not deviate from the AGA standard. Grades 1 - 12. Total sample = 6,287 subjects. Pilot 1967 - 68.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	154	57.7	208	73.8	208	81.9	223	85.4	235	86.4	235	87.4	234	88.0
Female	175	66,8	183	77.5	226	82.8	237	91.5	251	94.0	242	91.3	224	86.8
Total	329	62.2	391	75.5	434	82.4	460	88.5	486	90.2	477	89.3	458	87.4

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	241	86.1	227	88.3	253	91.0	234	90.0	229	94.2	2,681	84.1
Female	216	88.5	233	88.3	234	93.6	233	90.3	248	94.7	2,702	87.2
Total	457	87.2	460	88.3	487	92.2	467	90.2	477	94.5	5,383	85.6

TABLE 4. Moderate Articulation Deviation. Number and percentage of subjects judged to have an articulation pattern which deviated moderately from the AGA standard. Grades 1-12. Total sample = 6,287 subjects. Pilot 1967-68.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	99	37.1	69	24.5	45	17.7	34	13.0	37	13.6	32	11.9	31	11.7
Female	80	30.5	50	21.2	46	16.8	20	7.7	15	5.6	21	7.9	34	13.2
Total	179	33.8	119	23.0	91	17.3	54	10.4	52	9.6	53	9.9	65	12.4

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	38	13.6	29	11.3	24	8.6	25	9.6	13	5.3	476	14.9
Female	28	11.5	31	11.7	15	6.0	25	9.7	14	5.3	379	12.2
Total	66	12.6	60	11.5	39	7.4	50	9.7	27	5.3	855	13.6

TABLE 5. Extreme Articulation Deviation. Number and percentage of subjects judged to have an articulation pattern deviated extremely from the AGA standard. Grades 1-12. Total sample = 6,287 subjects. Pilot 1967-68.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	14	5.2	5	1.8	1	0.4	4	1.5	0	0.0	2	0.7	1	0.4
Female	8	3.1	3	1.3	1	0.4	2	0.8	1	0.4	2	0.8	0	0.0
Total	22	4.2	8	1.5	2	0.4	6	1.2	1	0.2	4	0.7	1	0.2

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	1	0.4	1	0.4	1	0.4	1	0.4	1	0.4	32	1.0
Female	0	0.0	0	0.0	1	0.4	0	0.0	0	0.0	18	0.6
Total	1	0.2	1	0.2	2	0.4	1	0.2	1	0.2	50	0.8

ysis will provide a means for determining the extent of articulatory deviation which would be considered significant.

Voice. During the first one-half of the data collection period which included the first 10 sampling points (2,924 subjects) a two-category scale for rating voice was used. Deviations of voice were judged to a criterion of "acceptable voice". Acceptable voice is defined grossly as one which is characterized by a clear laryngeal or resonantal tone. For pitch the produced voice was judged in relation to the subject's age and sex. In terms of voice quality three characteristics were judged namely, resonance, breathiness, and hoarseness without regard to sex or age. In the rating procedure the scale for voice was as follows.

Acceptable voice - no deviation from the standard
Voice deviation - some deviation from the standard including all magnitudes of deviation in terms of pitch and quality.

Tables 6 and 7 present the results from sampling points 1-10, approximately the first 50% of the subjects tested in the pilot study. As seen in Table 6, 93.3% of all subjects were judged to have a voice which did not deviate from the acceptable criterion. Table 7 shows that 6.7% of the subjects exhibited voices that deviated from the acceptable criterion. The seemingly high prevalence of 6.7% suggested that the rating scale should be expanded to a three-point continuum which would allow the rater to make a more discrete judgment. The evaluators observed that many younger children in the sample seemed to manifest very mild deviations from the acceptable voice criterion and since a forced judgment of "yes" or "no" was required the choice was too limited. If on the other hand, an opportunity to scale a deviation into a two-point judgment of "moderate deviation" or "extreme deviation", the task would be more realistic. Therefore, during the data collection period for the second 50% of the sample, a three-point scale was used, as follows.

Acceptable voice - no deviation from the standard.
Moderate deviation - some observable deviation from the standard which would not be considered severe or extreme.
Extreme deviation - a voice which deviates extremely from the acceptable voice standard.

In Table 8 the results show that 94.8% of the subjects tested in the last 50% of the sample were judged to have acceptable voices as compared to 93.3% for the first 50% of the sample. Table 9 indicates that 5.2% were judged to have a voice which deviated to a moderate degree from the standard. It can also be seen that only 0.03% of the subjects were judged to have deviated extremely from the standard as presented in Table 10.

TABLE 6. Acceptable Voice. Number and percentage of subjects judged to have a voice which did not deviate from the acceptable voice criterion. Grades 1-12. Total sample = 2,924 subjects. Pilot 1967-68. SP 1-10.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	111	87.4	123	89.8	109	90.8	107	91.5	116	92.8	122	87.8	121	93.8
Female	114	93.4	96	97.0	115	88.5	113	91.1	128	95.5	121	93.8	116	95.9
Total	225	90.4	219	92.8	224	89.6	220	91.3	244	94.2	243	90.7	237	94.8

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	130	93.5	107	93.0	111	94.1	114	97.4	104	97.2	1,375	92.3
Female	104	94.5	108	95.6	109	93.2	111	96.5	117	97.5	1,352	94.3
Total	234	94.0	215	94.3	220	93.6	225	97.0	221	97.4	2,727	93.3

TABLE 7. Voice Deviation. Number and percentage of subjects judged to have a voice which deviated from the acceptable voice criterion. Grades 1-12. Total sample = 2,924 subjects. Pilot 1967-68. SP 1-10.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	16	12.6	14	10.2	11	9.2	10	8.5	9	7.2	17	12.2	8	6.2
Female	8	6.6	3	3.0	15	11.5	11	8.9	6	4.5	8	6.2	5	4.1
Total	24	9.6	17	7.2	26	10.4	21	8.7	15	5.8	25	9.3	13	5.2

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	9	6.5	8	7.0	7	5.9	3	2.6	3	2.8	115	7.7
Female	6	5.5	5	4.4	8	6.8	4	3.5	3	2.5	82	5.7
Total	15	6.0	13	5.7	15	6.4	7	3.0	6	2.6	197	6.7

TABLE 8. Acceptable Voice. Number and percentage of subjects judged to have a voice which did not deviate from the acceptable voice criterion. Grades 1-12. Total sample = 3,363 subjects. Pilot 1967-68. SP 11-21.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	131	93.6	130	89.7	124	92.5	131	91.0	146	99.3	117	90.0	129	94.2
Female	133	95.0	127	92.7	129	90.2	128	94.8	124	93.2	128	94.1	131	95.6
Total	264	94.7	257	91.1	253	99.3	259	92.8	270	96.4	245	92.1	260	94.9

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	134	95.1	138	97.2	159	99.4	139	97.2	135	99.3	1,613	94.9
Female	126	94.1	144	95.4	132	99.2	138	96.5	135	95.1	1,575	94.7
Total	260	94.5	282	96.3	291	99.3	277	96.9	270	97.1	3,188	94.8

A comparison of the results from the two samples, that is, Table 7 compared with the combined totals in Table 9 and Table 10 indicates that the expanded rating scale used for judgment in the latter one-half of the sample did not appear to really separate the extreme voice deviations from the moderate deviations since only one subject with an extreme deviation was found. There are a number of possible explanations for this implied lack of "separating effect". In the first place the results from the second one-half of the sample suggest that most voice deviations are moderate and only a very small percentage can be rated as extreme. On the other hand the possible effects of dividing the total sample into two subsamples cannot be ignored. Also it is possible that the evaluators were not trained adequately enough to separate two distinct levels of voice deviation. This information was used to advantage in training the survey teams before beginning the data collection on the national sample this year. Based on preliminary sampling of results of voice judgments so far this year the expanded scale appears to be satisfactory.

Stuttering. Information on judged stuttering behavior is found in Table 11. For a subject to be judged as exhibiting stuttering behavior he was to have manifested the following behavior during the connected speech performance or at any time during the evaluation session.

1. Obvious prolongations and repetitions of speech utterances which disrupt the normal fluency of connected speech and,
2. Secondary behavioral characteristics such as struggle and other speech associated phenomena.

The total figure of 0.3% of the 6,287 subjects is somewhat lower than the prevalence range of 0.7% to 1.0% which has been reported in the past. The apparent significant difference between males, 0.6% and females, 0.1% as shown in Table 11 does support previous findings with regard to the direction of sex differences.

Overall Speech Performance. The rating of overall speech performance was made by judging the general impression of the connected speech pattern in terms of intelligibility primarily. As in the articulatory judgment the overall impression was judged against the AGA dialect standard. In making the judgment the evaluator considered the speech variables of articulation, voice, and fluency (stuttering) as combined factors as they might contribute to the overall impression. Since the primary characteristics had been judged earlier in the speech evaluation, the purpose of obtaining a rating of overall impression was to secure a more global assessment of speech performance. For example, a subject who may have been rated as "moderate" on the articulatory scale and "moderate"

TABLE 9. Moderate Voice Deviation. Number and percentage of subjects judged to have a voice which deviated moderately from the acceptable voice criterion. Grades 1-12. Total sample = 3,363 subjects. Pilot 1967-68. SP 11-21

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	9	6.4	15	10.3	10	7.5	13	9.0	1	0.7	13	10.0	8	5.8
Female	7	5.0	10	7.3	14	9.8	7	5.2	9	6.8	8	5.9	6	4.4
Total	16	5.7	25	8.9	24	8.7	20	7.2	10	3.6	21	7.9	14	5.1

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	7	4.9	3	2.1	1	0.6	4	2.8	1	0.7	85	5.0
Female	8	5.9	7	4.6	1	0.8	5	3.5	7	4.9	89	5.3
Total	15	5.5	10	3.4	2	0.7	9	3.1	8	2.9	174	5.2

TABLE 10. Extreme Voice Deviation. Number and percentage of subjects judged to have a voice which deviated extremely from the acceptable voice criterion. Grades 1-12. Total sample = 3,363 subjects. Pilot 1967-68. SP 11-21.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Female	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	0	0.0	1	0.7	0	0.0	0	0.0	0	0.0	1	0.05
Female	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.00
Total	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0	1	0.03

TABLE 11. Stuttering. Number and percentage of subjects judged to have exhibited stuttering behavior. Grades 1-12. Total sample = 6,287 subjects. Pilot 1967-68.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	2	0.7	2	0.7	1	0.4	1	0.4	4	1.5	1	0.4	0	0.0
Female	1	0.4	1	0.4	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0
Total	3	0.6	3	0.6	1	0.2	1	0.2	4	0.7	2	0.4	0	0.0

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	3	1.1	1	0.4	0	0.0	2	0.8	1	0.4	18	0.6
Female	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	0.1
Total	3	0.6	1	0.2	0	0.0	2	0.4	1	0.2	21	0.3

on the voice scale could be judged to be extremely deviant on overall performance. The rating scale for overall speech performance was as follows.

Acceptable overall speech - no deviation from the AGA dialect standard.

Mild overall speech deviation - slight deviation from the AGA dialect standard.

Moderate overall speech deviation - speech performance which deviated more than that which would be considered to be mild or only slightly less than acceptable.

Extreme overall speech deviation - speech performance which deviated extremely from the standard. This rating would include the most extreme deviations encountered.

As seen in Table 12, 83.3% of all subjects were judged to have acceptable overall speech. More precisely such a rating implies excellent speech since the speech performance was judged against the Adult General American dialect standard. In each of the twelve grades the percentage of females judged to have "acceptable" speech was consistently higher than males. The results further show that proficiency of speech performance increases somewhat consistently from the first to the twelfth grade for both males and females. Of particular interest and as was also shown in Table 3 (Acceptable articulation), there is a significant increase in speech proficiency between the first and second grade which does not occur between any other adjacent grade groups. These comparative results suggest that these aspects of speech performance develop rapidly during the first year of school, possibly because of maturational factors alone, first grade experiences alone, or the combined effects of the two. Also one is led to believe that articulatory performance and overall speech performance are closely related.

Ratings of the three levels of deviation from the AGA dialect standard are summarized in Tables 13, 14 and 15. The percentage of subjects who were judged to have an overall speech performance which deviated "mildly" is shown in Table 13. The relatively poorer performance of males as compared to females in each grade except the twelfth is evident. The same general pattern of performance carries through the other two ratings of overall speech performance as summarized in Table 14 (Moderate deviation) and Table 15 (Severe deviation). The scaled rating of "moderate deviation" was applied to 1.4% of the subjects and a rating of "severe deviation" to 0.3%. From the results of the three ratings of voice deviation it would appear that at least 0.3% of the subjects exhibited speech patterns which could be defined as "defective". Also, it may be that some of the 86 (1.4%) subjects who were judged "moderately deviant", presented speech patterns which could be defined as defective in

TABLE 12. Acceptable Overall Speech Pattern. Number and percentage of subjects judged to have a total speech pattern which did not deviate from the AGA standards. Grades 1-12. Total sample = 6,287 subjects. Pilot 1967-68.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	149	55.8	198	70.2	196	77.2	204	78.2	227	83.5	214	79.6	225	84.6
Female	168	64.1	182	77.1	215	78.8	226	87.3	243	91.0	228	86.0	228	88.4
Total	317	59.9	380	73.4	411	78.0	430	82.7	470	87.2	442	82.8	453	86.5

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	236	84.3	218	84.8	259	93.2	232	89.2	229	94.2	2,587	81.1
Female	213	87.3	234	88.6	235	94.0	233	90.3	246	93.9	2,651	85.6
Total	449	85.7	452	86.8	494	93.6	465	89.8	475	94.1	5,238	83.8

TABLE 13. Mild Overall Speech Deviation. Number and percentage of subjects judged to have a total speech pattern which deviated mildly from the AGA standard. Grades 1-12. Total sample - 6,287 subjects. Pilot 1967-68.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	89	33.3	77	27.3	57	22.4	49	18.8	40	14.7	50	18.6	38	14.3
Female	84	32.1	49	20.8	56	20.5	30	11.6	23	8.6	35	13.2	28	10.9
Total	173	32.7	126	24.3	113	21.4	79	15.2	63	11.7	85	15.9	66	12.6

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	39	13.9	35	13.6	17	6.1	26	10.0	12	4.9	529	16.6
Female	30	12.3	30	11.4	14	5.6	23	8.9	16	6.1	418	13.5
Total	69	13.2	65	12.5	31	5.9	49	9.5	28	5.5	947	15.1

TABLE 14. Moderate Overall Speech Deviation. Number and percentage of subjects judged to have a total speech pattern which deviated moderately from the AGA standard. Grades 1-12. Total sample = 6,287 subjects. Pilot 1967-68.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	20	7.5	7	2.5	0	0.0	7	2.7	4	1.5	4	1.5	2	0.8
Female	10	3.8	4	1.7	1	0.4	3	1.2	1	0.4	2	0.8	2	0.8
Total	30	5.7	11	2.1	1	0.2	10	1.9	5	0.9	6	1.1	4	0.8

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	5	1.8	4	1.6	2	0.7	2	0.8	2	0.8	59	1.9
Female	1	0.4	0	0.0	1	0.4	2	0.8	0	0.0	27	0.9
Total	6	1.1	4	0.8	3	0.6	4	0.8	2	0.4	86	1.4

TABLE 15. Extreme Overall Speech Deviation. Number and percentage of subjects judged to have a total speech pattern which deviated extremely from the AGA standard. Grades 1-12. Total sample = 6,287 subjects. Pilot 1967-68.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	9	3.4	0	0.0	1	0.4	1	0.4	1	0.4	1	0.4	1	0.4
Female	1	0.4	1	0.4	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0
Total	10	1.9	1	0.2	2	0.4	1	0.2	1	0.2	1	0.2	1	0.2

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	14	0.4
Female	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	0.1
Total	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	17	0.3

the final analysis. A more sophisticated analysis which is being programmed will compare the four subjective evaluations of speech performance with the phonemic analysis obtained by use of the Goldman-Fristoe Articulation Test. By means of these intercomparisons it is expected that a reliable description of a "speech disorder" as well as "normal speech" by grade level will be possible.

HEARING BEHAVIOR - Procedure and Results

Test Environment and Apparatus. Hearing tests were conducted in a sound-treated chamber (IAC-401) mounted in the mobile units. This room met the minimum specifications for sound levels currently under consideration by the International Standards Organization. Further confirmation of room adequacy was obtained during pilot studies prior to the survey.

All measures of auditory sensitivity were obtained on modified audiometers (Maico-MA-11). The major modification involved the inclusion of potentiometers which permitted actual physical corrections in the instruments' output by the field personnel. Each test unit also included an auxillary audiometer, a voltmeter (Simpson-715), and an artificial ear (Rudmose-RA 106A). The two latter instruments were utilized for calibration purposes. The test audiometers were calibrated in three ways at the beginning and again at the end of each work day: 1) electrical measures of the audiometers' oscillators were made with the voltmeter; 2) acoustical measures of the audiometers' outputs were taken from the earphones with the artifical ear, and ; 3) biological calibrations were performed on the examiners' ears. This system provided a three-way check on the accuracy of the audiometers.

Subject Preparation. An average time of six minutes was alloted to establish the threshold-of-hearing on each child. As the subject entered the test chamber he was seated in such a position that he could not see the audiometer, the evaluator's arm, hand or eye movements. He was then given the following instructions:

> "You're going to listen for some sounds, all of which will be fairly faint. Whenever you hear one of the sounds, no matter how faint it is, raise your arm like this (demonstrate) so that I can easily see it. When the sound stops, put your arm down."

The earphones were carefully positioned over the child's ears, noting that each pinna was entirely covered. The phones were then tightened in the headband so that they fitted snugly, but comfortably.

Test Frequency and Ear Sequence. A 1000 Hz tone was initially presented to each subject as a "learning" frequency, the threshold for which was not recorded. After establishing threshold for this frequency, which served to orient the child to the situation, a formal testing sequence was presented according to the following schedule:

1. Code 1 children - left ear tested first (green data recording sheet). Frequency order: 4 KHz- .5 KHz - 2 KHz - 3 KHz - 1 KHz.
2. Code 2 children - right ear test first (white data recording sheet). Frequency order: 3 KHz - 1 KHz - 2 KHz - .5 KHz - 4 KHz.

Tone Presentation and Rhythm Pattern. Tone durations were varied from one to two seconds, and with varying time intervals between stimulus presentations. This procedure was designed to minimize the likelihood of the child adopting a rhythmic response pattern.

Threshold Determination Technique. The Hughson-Westlake ascending technique was utilized for all threshold explorations. Specifically, the first test tone (the 1000 Hz "learning" tone) was presented at 40 dB re ISO-1964 audiometric zero. This level permitted the child to become familiar with the type of test stimulus to which he must attend. Following his response at this level, the tone was presented in successively decreasing 10 dB steps until the child failed to respond. The stimulus was then increased in 5 dB increments until a response was once again obtained. This "down ten - up five" procedure was repeated until the hearing level at which the child responded at least half of the time was determined. This value was recorded as the child's threshold. A minimum of three ascents was made for each threshold measurement. After this orientation activity, the procedure for formal measurements was modified slightly by substituting a beginning test level of 20 dB for the original 40 dB level. Pilot experiments revealed that thresholds obtained in this manner were just as reliable as the 40 dB procedure and resulted in a substantial saving of time.

Whenever a child responded at 0 dB, a minimum of three stimulus presentations was made to confirm the child's response. No effort was made to obtain responses below zero audiometric level, a decision which was based on several factors: 1) zero hearing level on the ISO-1964 reference scale represents superior hearing acuity; 2) it would have necessitated modifying the audiometer to render greater attenuation than it normally provides (and greater than a manufacturer is required to provide by the United States of American Standards Institute; 3) it would have involved considerably greater time, and ; 4) adequate protection against ambient noise afforded by the Model 401 test chamber at 500 Hz was limited to audiometric zero and above.

Whenever a child failed to respond at the initial measurement level (20 dB) the tester rapidly ascended in 20 dB steps until a response was elicited. The usual procedure for threshold determination then ensued.

Masking Procedures. Unmasked thresholds were initially established on both ears of every child. In instances where the hearing levels in the child's two ears differed by 40 dB or more at any frequency, 85 dB (SPL) of white noise was supplied to the child's better ear while his poorer ear was retested. His responses in the poorer ear were re-established under this condition for all frequencies, and were reported as his true organic-threshold values.

Reliability Judgments of Subject Performance. Judgments regarding reliability of the child's test performance were made on every subject. If, in the evaluator's opinion, the performance was judged unreliable, such a notation was entered on the data recording sheet. Moreover, the evaluator was required to indicate whether the lack of reliability was due to: 1) the child's behavior; 2) environmental factors; 3) a physical deformity, or; 4) a combination of these classifications. Whenever a child's thresholds were difficult to establish, or appeared inconsistent, no repeat tests were performed. The measurements obtained within the allowable time limit were simply recorded and an appropriate judgment made concerning the reliability of the test.

Evaluator Reliability. Reliability assessments on all evaluators were conducted in each sample district. This task was accomplished by having two subjects in each district tested by all three evaluators independently. Statistical analysis of the results, though not reported in detail in this report, have shown excellent reliability.

Results. Initially, results were analyzed to determine the overall degree of reliability of the total sample. These results, shown in Table 16, reveal that reliability was generally excellent at all grade levels. However, as one might expect, reliability also generally increased with grade level. The only exception may be observed for the 11th graders. This result, though, has relatively little meaning at this point in the project because of the small N's. Also expected, if you are a male, was the finding that male subjects were more reliable than females.

Table 17 shows the distribution, by sex and grade, of reliable subjects exhibiting hearing acuity in both ears which fell within a range considered to be the "best human hearing (0-20 dB, ISO-1964) at all test frequencies. This classification contained 91.8% of

TABLE 16. Number and percentage of unreliable subjects.* Males and females. Grades 1-12. Total sample = 6,157 subjects. Pilot 1967-68.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	10	.037	15	.053	9	.035	2	.008	2	.007	2	.007	2	.008
Female	20	.076	12	.051	7	.026	12	.046	4	.015	6	.023	2	.008
Total	30	.056	27	.052	16	.030	14	.027	6	.011	8	.015	4	.008

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	3	.011	2	.008	4	.014	3	.012	0	.000	54	.017
Female	4	.016	1	.004	3	.012	8	.031	0	.000	79	.025
Total	7	.013	3	.006	7	.013	11	.021	0	.000	133	.021

* An unreliable measure means, in the evaluator's judgment, that the obtained result does not represent the child's true organic thresholds and assumes it would not be repeatable on subsequent tests.

TABLE 17. Number and percentage of subjects exhibiting bilaterally superior hearing acuity (0-20 dB ISO, 1964). Males and females. Grades 1-12. Total sample = 6,157 subjects.

Grade	1		2		3		4		5		6		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	231	89.9	244	91.4	222	90.6	239	92.3	246	91.1	241	90.3	237	89.8
Female	223	91.4	203	90.6	245	92.1	230	93.1	250	95.1	243	93.8	243	94.6
Total	454	90.6	447	91.0	467	91.4	469	92.7	496	93.1	484	92.0	480	92.1

Grade	8		9		10		11		12		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Male	251	90.6	235	92.2	228	83.2	230	89.5	206	84.8	2810	89.6
Female	230	95.8	250	95.1	237	96.0	239	95.6	247	94.3	2840	94.0
Total	481	93.0	485	93.6	465	89.3	469	92.5	453	89.7	5650	91.8

the total population. Females showed a rather consistent superiority over males, with only second-grade males having a higher percentage of response at this sensitivity level. Interpretation of this result is hazardous at this point, but many authorities attribute this relatively common observation to greater noise exposure among boys. We are unwilling to make such a judgment, at least for the present. In terms of findings by grade, albeit age, some tendency was shown for better hearing in the older children. Interpretation of this finding is also difficult except in terms of subject reliability as shown in Table 17. Except for two notable deviations, the males in grade 10 and 12, the percent of subjects with superior hearing fell near 90% or better for all grades.

Table 18 was designed to show the distribution of the 507 (8.2%) subjects who deviated in some way from those with bilaterally normal acuity (arbitrarily defined for present purposes). These data present deviations, in number and percent, for ear, sex, and grade level. A most striking result is the fact that only eight children, from among the total sample of 6,157 youngsters, exhibited bilateral departures from the criterion norm. Perhaps such a result should be expected since all children in the survey were selected from regular classrooms. That is, no children who were attending special schools or classes for the hearing-impaired were included in the study. This almost infinitesimal number, representing only .001% of the total sample, may be assumed to be children whose impairments were as yet undiscovered, were so marginal they represent only minimal handicaps, or were children who were compensating adequately for their impairment.

The balance of this table, 499 children, represents youngsters with impairments in only one ear which were relatively equally divided between left and right ears. Overall, the slightly greater number of left ears were provided primarily by male subjects. A rather astonishing result was the substantially greater number of males with hearing impairments. The percentage was almost double that found among females, 64.1% and 35.9%, respectively. Speculation concerning the reason(s) for this finding is hazardous, as pointed out previously. Thus, the compelling desire to comment further is deferred until the completion of the survey.

Table 18 also presents most interesting data regarding the distribution of children with deviant hearing acuity by grade level. It may be observed that little difference was found between grades. Results ranged from a low of 33 children in the ninth grade to a high of 56 subjects in the tenth grade. These results have interesting implications for Public School Hearing Conservation Programs. While most authorities agree that it would be desir-

TABLE 18. Number and percentage of subjects whose hearing deviated from the 20 dB criterion limits. Males and females. Grades 1-12. Total = 507 subjects out of 6,157 children tested.

Grade	1					2					3				
	L	R	B	T	%	L	R	B	T	%	L	R	B	T	%
Male	11	15	0	26	5.1	12	11	0	23	4.5	11	12	0	23	4.5
Female	4	17	0	21	4.1	16	5	0	21	4.1	11	10	0	21	4.1
Total	15	32	0	47	9.2	28	16	0	44	8.6	22	22	0	44	8.6
Percent	3.0	6.3	0			5.5	3.2	0			4.3	4.3	0		

Grade	4					5					6				
	L	R	B	T	%	L	R	B	T	%	L	R	B	T	%
Male	9	11	0	20	3.9	15	9	0	24	4.7	13	12	1	26	5.1
Female	8	9	0	17	3.4	2	11	0	13	2.6	7	8	1	16	3.1
Total	17	20	0	37	7.3	17	20	0	37	7.3	20	20	2	42	8.2
Percent	3.3	3.9	0			3.3	3.9	0			3.9	3.9	.4		

Grade	7					8					9				
	L	R	B	T	%	L	R	B	T	%	L	R	B	T	%
Male	12	14	1	27	5.3	17	8	1	26	5.1	10	9	1	20	3.9
Female	8	6	0	14	2.7	6	3	1	10	2.0	5	8	0	13	2.6
Total	20	20	1	41	8.0		23	2	36	7.1	15	17	1	33	6.5
Percent	3.9	3.9	.2			4.5	2.1	.4			2.9	3.3	.2		

L = Left ear
R = Right ear
B = Binaural
T = Total

Table 18 (Continued)

Grade	10					11					12				
	L	R	B	T	%	L	R	B	T	%	L	R	B	T	%
Male	28	18	0	46	9.0	17	10	0	27	5.3	25	10	2	37	7.3
Female	6	4	0	10	2.0	6	5	0	11	2.1	8	7	0	15	2.9
Total	34	22	0	56	11.0	23	15	0	38	7.4	33	17	2	52	10.2
Percent	6.7	4.3	0			4.5	2.9	0			6.5	3.3	.4		

Grade	Total			
	L	R	B	T %
Male	180	139	6	325 = 64.10
Female	87	93	2	182 = 35.90
Total	267	232	8*	507** = 100.00
Percent	52.66	45.76	1.58	

L = Left ear
R = Right ear
B = Binaural
T = Total

* .001 percent of the total sample of 6,157 children

** 8.2 percent of the total sample of 6,157 children

able to screen at all grade levels, budget limitations usually preclude such plans. In that event, a common alternative is to concentrate efforts at the lower grade levels. The latter philosophy is based on the idea that impairments should be identified and treated during the important early years when communication skills are developing. Most other arguments for early recognition and management apply equally to all age groups. However, regardless of the rationale for limited-grade screening programs, the present results argue persuasively for screening at all grade levels on a regular basis.

Other data analyses are currently in progress which will, ultimately, permit us to present information in considerably greater detail.

SUMMARY AND DISCUSSION

A tentative interpretation of the speech and hearing results as analyzed and reported indicates that the primary purpose of the pilot study was accomplished. In an effort to determine the feasibility of conducting a national study it was important to examine data which had been collected according to a prescribed method. It was assumed that the data analysis would furnish answers to broad questions such as:

1. Is it possible to enlist the cooperation of widely dispersed school systems in data collection?
2. Can a predetermined number of subjects be tested or screened in a well defined period of time such as a school year which extends from September to June?
3. How stable is electronic equipment when installed in mobile units which are moved frequently?
4. Is it possible for personnel to function reliably over a long period of time under conditions of a rigid testing schedule.

Essentially the purpose was to evaluate several aspects of reliability including the sample, equipment stability and evaluator reliability under operational conditions dictated by the methodology.

The nature of the survey project is such that ultimate success does not depend on testing a specific hypothesis. Primarily the project is designed to collect a large mass of data which, when analyzed, will describe speech and hearing behavior of a sample of school age children. In formulating the methodology certain assumptions about speech and hearing behavior were made.

Initially it was assumed that an acceptable definition of a speech disorder did not exist since specific reliable criteria for making the judgment are not clearly described. A certain amount of

variability is characteristic of speech and the limits of the variability for acceptable or normal speech are broad rather than narrow when considering age, sex, and sociological strata. In addition professionals do not always agree on criteria for defining normal or disordered speech. To avoid this problem it was decided to which speech performance would be compared.

Secondly, previous studies of speech performance have shown that proficiency in articulation increases with age and therefore it was assumed that there is an acceptable level of performance in the first grade as well as the third. If such is the case then articulatory performance must be evaluated at all grade levels since it must be assumed further that differences would occur between grades. Also previous studies have indicated that girls develop articulatory skills earlier than do boys. If true, comparisons between sexes at all grade levels must be made. Such an analysis should yield not only much needed normative data but also establish a standard to which degrees of deviation can be compared and evaluated. Once the disorder is defined reliable prevalence figures can be obtained.

The analytical procedure required to define terms such as "normal articulation", normal voice", "articulation disorder", and "voice disorder" is not simple. One technique to be used to define "speech disorder" is to determine the relationship between the levels of subjective ratings of speech and the phonemic analysis results. Ultimately innumerable intercomparisons of this order will be made to answer many questions about speech behavior.

The results on the speech data for the pilot study support the basic assumptions regarding articulatory behavior. In terms of "acceptable" or "excellent" speech the data show that articulatory proficiency increases with age and the female speech does "mature" earlier than that of males. For moderate and extreme deviations the same pattern is reflected in that more moderate and extreme deviations from the AGA dialect standard were found in the younger subjects and also in the males. The next step will be to translate "deviations" into "disorders" and then to calculate the prevalence values. The results of the subjective ratings of articulation and overall performance are reasonable and are predictable in terms of age levels and sex.

The results on stuttering, a characteristic of speech which was defined before data were collected, are quite acceptable although the prevalence figure of 9.3% is lower than the figure usually reported. The implications of the reduced prevalence figure were

discussed earlier.

As anticipated the rating of voice is one of the most difficult tasks for the evaluator. Without additional analyses the results are difficult to interpret because of the voice factors which contribute to a judgment of voice deviation. For example 36% or 63 of the 3363 subjects were judged to have a moderately breathy voice. In defining "voice disorder" the significance of breathiness will have to be taken into account. It may be that breathiness, for example, is found frequently enough to be considered as an expected quality.

Additional analyses which will provide more comprehensive information regarding speech behavior are being programmed at the present time.

The reported hearing results indicate that subject reliability is excellent and that the testing environment and procedures were very satisfactory. Current and proposed data analyses of the hearing data will offer the opportunity to describe the function of hearing even more meaningfully.

Ultimately hearing results will be compared with speech behavior data to determine the interrelationship between these two aspects of oral communication.